Technical Information Manual

Revision n. 6
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MOD. A1932 A

48 CHANNEL 3 kV/ 500 µA
DISTRIBUTOR BOARD
MANUAL REV.6

NPO:
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CAEN declines all responsibility for damages or injuries caused by an improper use of the Modules due to negligence on behalf of the User. It is strongly recommended to read thoroughly the CAEN User's Manual before any kind of operation.

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1. Introduction

1.1 The CAEN Universal Multichannel Power Supply System

The SY 1527 system is the fully equipped, large scale experiment version of the latest CAEN Universal Multichannel Power Supply System. This system outlines a completely new approach to power generation and distribution by allowing to house, in the same mainframe, a wide range of boards with different functions, such as High/Low Voltage boards, generic I/O boards (temperature, pressure monitors, etc.) and branch controllers, where the latter are used to control other remote generators and distributors.

Modularity, flexibility and reliability are the key-points of its design, enabling this module to meet the requirements of a wide range of experimental conditions. The latter range from those of LHC experiments, in which the model's features find prior application, to those of other less challenging, but still demanding, High Energy Physics experiments.

The system is housed in a 19"-wide, 8U-high euro-mechanics rack and hosts four main sections:

- the *Board Section*, with 16 slots to house boards, distributors and branch controllers;
- the *Fan Tray Section*, housing 6 fans disposed on two rows;
- the *Power Supply Section*, which consists of the primary power supply and up to 3 power supply units;
- the *CPU and Front Panel Section* which includes all interface facilities.

The User interface features the usual friendliness of the previous CAEN systems which now also includes a 7.7" colour LCD. A wide choice of interfaces provides full communication compatibility with the previous systems and the possibility of controlling heterogeneous external devices.

Modularity has been one of the leading criteria in the design and development of the system: both the *Power Supply Section* and the *Board Section* are completely modular. The *Power Supply Section* allows different configurations with up to 3 power supply units per mainframe (up to 2250 W), while the *Board Section* can house up to 16 boards able to fulfil different functions. A new line of boards and distributors, analogous with those available for the SY 527 system, and a set of branch controllers has been specially developed for this new system. The minimum system configuration consists of the primary power supply, one Power Supply Unit and one board.

The extreme flexibility of the system, which allows to mix freely, inside the same mainframe, boards with different functions, is further enhanced by the possibility of developing *ad-hoc* boards and even complete custom peripheral systems. The latter, actually, can be designed specifically for on-detector installation. All the custom electronics can be anyway remotely controlled by single boards which are inserted in the SY 1527 mainframe and act as branch controllers.

Fast, accurate set-up and monitoring of system parameters (14-bit resolution on Voltages and Currents with standard boards) is available for each branch controller thanks to the use of one microprocessor per slot. All the operational parameters are stored in a non-volatile

memory (EEPROM) to be still available after Power-Off. The parameters can be controlled either via CAEN traditional built-in links (RS232, H.S. CAENET) or via CERN-approved Fieldbuses or via Ethernet (TCP/IP). Programmable handling of parameters and errors is available as well.

Channel trip control on other crates is performed via four external differential trip lines. A sophisticated trip handling via software allows to control and correlate trip conditions on the channels of the crate as well as of other crates connected to it.

Live insertion and extraction of the boards, which reduces the global down time, and easy access to the computing core and peripherals completes the system's flexibility.

Easy interfacing is another key-point of the SY 1527 system. Thanks to the H.S. CAENET interface, the system ensures full communication compatibility with the previous models. Besides the RS232 interface and Ethernet (TCP/IP) provided with the standard version of the system, CAN-bus can be furnished on request, as well as special boards featuring optical links for remote communications. The Power Supply Section and Board Section can be externally synchronised via front panel connectors.

Secure access to the system via Intranet is foreseen together with a multilevel management of custom User's profiles. In particular, three different access levels have been implemented: *Guest*, *User* and *Administrator*; the three of them are password protected.

Handy maintenance and upgrading, which constitute a major issue in the reliability of a system, are further guaranteed by the possibility of accessing and servicing the system via network facilities. Actually, Telnet access allows remote debugging and technical support of the system, including firmware upgrading.

For a detailed description of the SY 1527 Universal Multichannel Power Supply System please refer to the *SY 1527 User's Manual* .

1.2 Technical Specifications Table of the SY 1527 system

Table 1.1 Technical specifications of the SY1527 mainframe: general

Packaging	- 19"-wide, 8U-high Euro-mechanics rack; - Depth: 720 mm.
Weight	-Mainframe (*): 24 kg -Mod. A1532: 3.2 kg
Power requirements	*Voltage range*: 100/230 Vac *Frequency*: 50/60 Hz *Power*: 3400 W
Max. number of boards per crate	16
Max. number of power supply units per crate	3
Primary power supply output (Mod. A 1531)	± 12 V, 8 A +5 V, 20 A
Power supply unit output (Mod. A 1532)	+48 V, 15.6 A
Max. output power	2250 W
Operating temperature	From 0°C (dry atmosphere) to +40°C
Storage temperature	From -20°C (dry atmosphere) to +50°C

(*) One Primary Power Supply (Mod. A 1531) and one Power Supply Unit (Mod. A 1532) are included; boards are not included.

2. Mod. A1932A Floating Distributor Board

2.1 Functional description

The Model A1932A, High Voltage Positive (Mod. A1932AP) or Negative (Mod. A1932AN) Floating Distributor Power Supply Board for the SY1527 System, is a 48 Channel board with a maximum output voltage of 3 kV. The board is double-width.

The Board houses a Primary High Voltage Channel and 48 Distributed Output Channels, directly supplied by the Primary Channel.

The internal Primary HV Channel has a complete set of parameters that can be programmed, such as high voltage, current limit, voltage RAMP-UP and RAMP-DOWN.

The 48 Output Channels are organised into six 8-channel Groups. Most functional parameters can be programmed individually for each output channel, others, such as safety limits, can be set over a group or over the primary channel.

The HV RAMP-UP and RAMP-DOWN rates may be selected independently for each channel in the range 1÷ 500 V/s in 1 V/s steps.

The Primary Channel and each group feature independent ON/OFF switching (i.e. if the *group*X is ON and the primary channel is OFF, at the primary channel's switching ON, the channels in the *group*X will automatically ramp up), see § 4.1 for details.

The output channels share a common floating ground (i.e. the output voltages are not referred to the crate's ground reference). Both the floating ground (FAGND) and the crate ground (AGND) are available on front panel connectors.

The Primary Channel current is monitored with a 10 μA resolution; if a current larger than the programmed limit ISET is drawn, OVERCURRENT condition is signalled; the board controller detects this state as a fault and reacts turning off the channel: the maximum current that the primary channel can draw is 30 mA (see § 4.1.1). OVERCURRENT is monitored over each group as well: if one group tries to draw more than 10 mA, it trips (see § 4.1.3); this value is hardware-fixed, thus not programmable.

The board hosts also a temperature sensor located on the PCB near the HV channels: the temperature values measured by this sensor are used to signal Over Temperature condition on the SY 1527.

The voltage on each Distributed Output Channel can be independently programmed in a range of 100÷900 V drop from the Primary Channel voltage setting, with a maximum current of 0.5 mA.

If the user tries to set an outside-drop value via software, the SY1527 returns an error message (either OVV=overvoltage or UNV=undervoltage). Moreover if the Primary Channel's voltage value is updated, the output channels must be updated as well, in order to remain within the allowed limits.
Actually when the Primary Channel voltage is updated, the Distributed Output Channels which are no longer whithin the drop, are somehow "automatically updated", but their

operating condition is not proper (for example ripple may increase and accuracy may decrease, with respect to the values given in § 2.2), until their Vset parameter is updated by the User.
EXAMPLE: the Primary Channel is set at 2000 V and Channel X is at 1450 V; if the Primary Channel is brought at 2500 V, Channel X Vset must be updated at 1600 V [1] at least.

The output voltages are provided via a Radiall 52-pin connector.
The multipin output connector has two pins dedicated to realize the safety board interlock (see § 4.2). This protection allows to disable the primary HV generation when the A1932 A outputs are not connected to their loads.

[1] Channel X will be actually brought up automatically at 1600 V in this case, but its Vset must be updated anyway by the User for correct operation, otherwise UNV is signalled and ripple might increase.

2.2 Technical Characteristics Table

Table 2.1 - Technical characteristics of the Mod. A1932A Distributor Board

Polarity:	Positive / Negative depending on purchased version
Primary Voltage:	0÷3.1 kV
Max Primary Current:[2]	30 mA (programmable)
Max Group Current:[2]	10 mA (fixed)
Output Channel Voltage:	0÷3.0 kV
Max Output Channel Current:	0.5 mA
Primary-Output drop:	100÷900 V
Voltage set / Monitor Resolution:	200 mV (Primary; Output)
Current set / Monitor Resolution	20 µA (Primary)
VMAX software:	3.1 kV (Primary)
VMAX software resolution:	1 V
Ramp Down:	1÷500 Volt/sec, 1 Volt/sec step
Ramp Up:	1÷500 Volt/sec, 1 Volt/sec step
Voltage Ripple:[3]	< 30 mV pp
Voltage Monitor vs (Output; Primary) Voltage Accuracy:[4]	± 1 V ± 0.1% of reading (Output) ± 5 V ± 1% of reading (Primary)
Voltage Set vs Voltage Monitor Accuracy:[4]	± 1 V ± 0.1% of setting
Current Monitor vs. Primary Current Accuracy:[4]	± 50 µA ± 2% of reading
Current Set vs. Current Monitor Accuracy:[4]	± 50 µA ± 2% of setting (Primary)

[2] This is the threshold of the Overcurrent protection intervention

[3] From 1 kHz to 15 MHz at full load and Channel Vset programmed whithin the allowed voltage drop

[4] From 10% to 90% of Full Scale Range and Channel Vset programmed whithin the allowed voltage drop

2.3 Front Panel

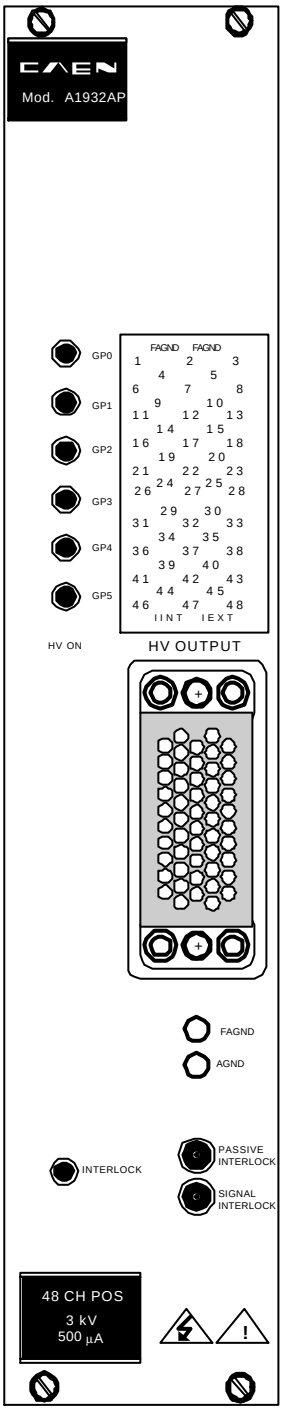

Fig. 2.1 – Mod. A1932A front panel

2.4 Technical Specifications

2.4.1 Packaging

The Mod. A1932A module is housed in a 10 TE-wide, 6U-high mechanics. It occupies two SY1527 slots (double-width).

2.4.2 External connections

The location of all components of the front panel is shown in Fig. 2.1. The function and electro-mechanical specifications of the external connectors are listed in the following subsections.

Output Channels (1…48); **Floating Ground (FAGND);** **IINT, IEXT:**	Multipin connector Radiall 691803004 type, 52 pin male (to be mated with Radiall 691802002 [*SCEM 09.41.34.700.2*] type[5]); see Fig. 2.2 for pin assignment
FAGND:	Radiall R921921 socket, Ø 2mm; see § 4.3
AGND:	Radiall R921921 socket, Ø 2mm; see § 4.3
PASSIVE INTERLOCK:	00-type LEMO connector; see § 4.2
SIGNAL INTERLOCK:	00-type LEMO connector; see § 4.2

[5] Requires 52 pins Radiall 691804300 [*SCEM 09.41.33.830.7*] type, to be inserted using the insertion/extraction tool Radiall 282549024 [*SCEM 34.95.17.125.3*] type.

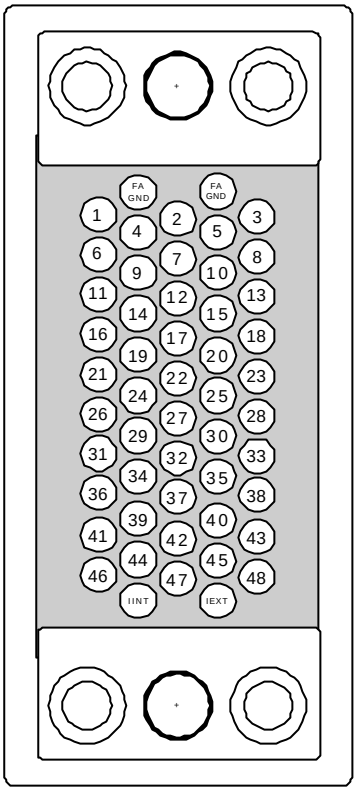

Fig. 2.2 – Mod. A1932A HV Multipin Connector

2.4.3 Displays

GROUP 0..5 LEDs:

Function: they light up as the relevant group is on.

Type: red LEDs for positive polarity version; yellow LEDs for negative polarity version.

INTERLOCK LED:

Function: it lights up as none of the interlocks (connector interlock, passive interlock, signal interlock) is active and the channel can be turned on.

Type: green LED.

2.4.4 Jumpers

Jp1:

Function: if connected, it allows to match the Floating Analog Ground (FAGND) with the ground of the crate (AGND). See § 4.3.

Factory setting: **connected**

Jp2: *Function:* if connected, enables the channels switching on, regardless the Passive or the Signal INTERLOCK setting. See § 4.2.

Factory setting: **disconnected**

Jp3: *Function:* if connected, enables the channels switching on, regardless the Connector INTERLOCK status. See § 4.2.

Factory setting: **disconnected**

See Fig. 2.3 for jumpers' position.

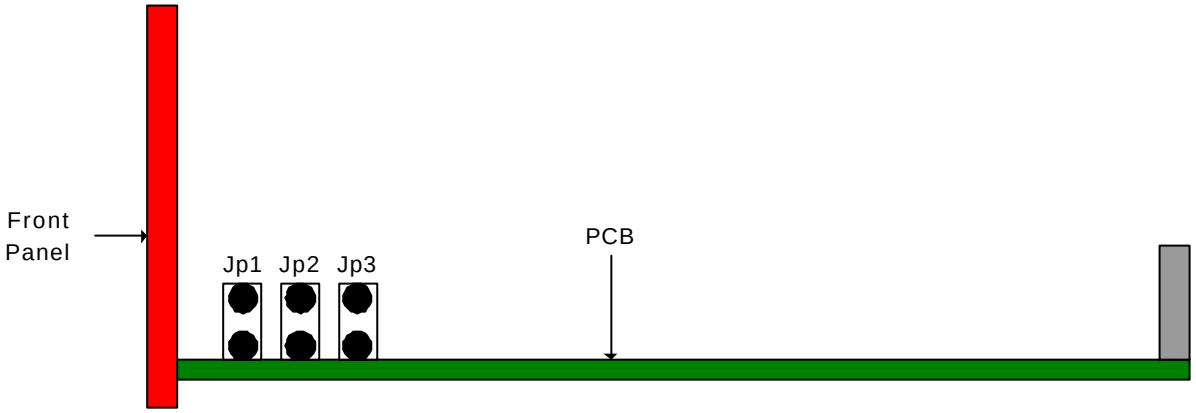

Fig. 2.3 – Mod. A1932A (view from bottom)

3. Safety information and installation requirements

3.1 General safety information

This section contains the fundamental safety rules for the installation and operation of the boards. Read thoroughly this section before starting any procedure of installation or operation of the product.

3.1.1 Injury Precautions

Review the following precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use the product only as specified. Only qualified personnel should perform service procedures.

Avoid Electric Overload.
To avoid electric shock or fire hazard, do not apply a voltage to a load that is outside the range specified for that load.

Avoid Electric Shock.
To avoid injury or loss of life, do not connect or disconnect cables while they are connected to a voltage source.

Do Not Operate Without Covers.
To avoid electric shock or fire hazard, do not operate this product with covers or panels removed.

Do Not Operate in Wet/Damp Conditions.
To avoid electric shock, do not operate this product in wet or damp conditions.

Do Not Operate in an Explosive Atmosphere.
To avoid injury or fire hazard, do not operate this product in an explosive atmosphere.

Do Not Operate With Suspected Failures.
If you suspect there is damage to this product, have it inspected by qualified service personnel.

3.2 Safety Terms and Symbols on the Product

These terms may appear on the product:

- **DANGER** indicates an injury hazard immediately accessible as you read the marking.
- **WARNING** indicates an injury hazard not immediately accessible as you read the marking.
- **CAUTION** indicates a hazard to property including the product.

The following symbols may appear on the product:

DANGER

High Voltage

ATTENTION

Refer to Manual

3.3 Installation

The Mod. A1932A is a double-width board which occupies two SY 1527 slots. At power ON the SY 1527 system processor will scan all the slots in the crate to find out where the module is plugged and what kind of module it is.
N.B.: the board does not allow “live extraction”; the system must be turned off before removing the board.

4. Operating modes

The Mod. A1932A board can be controlled, either locally or remotely, through the SY 1527 software interface. For details on SY 1527 system operation, please refer to the User's Manual of this product. The following sections contain a description of commands available for the board control and status monitoring.

ATTENTION

THE MOD. A1932A BOARD REQUIRES

SY 1527 FIRMWARE VERSION 1.09.04 OR LATER

4.1 Output control and monitoring

4.1.1 Primary Channel operations

It is possible, through the SY 1527 system, to perform the following operations over the **primary channel**:

- Assign to the channel a symbolic name (NAME)
- Set voltage (VSET)
- Set max. current (ISET)
- Set voltage software limit (SVMAX)
- Set voltage ramp-up speed (RAMPUP)
- Set voltage ramp-down speed (RAMPDOWN)
- Switch channel ON/OFF (Pw)
- Monitor voltage (VMON)
- Monitor current (IMON)
- Monitor board's temperature (TEMP)

The channel is automatically turned off when OVC (threshold: 30 mA) occurs (PDwn)

4.1.2 Output Channel operations

It is possible, through the SY 1527 system, to perform the following operations over each **output channel**:

- Assign to the channel a symbolic name (NAME)
- Set output voltage (VSET)
- Monitor output voltage (VMON)

- Set output voltage software limit (SVMAX)
- Set voltage ramp-up speed (RAMPUP)
- Set voltage ramp-down speed (RAMPDOWN)

4.1.3 Group operations

For each **8-channel group**, it is possible, through the SY 1527 system, to perform the following operations:

- Assign to the group a symbolic name (NAME)
- Switch group ON/OFF (Pw)
- Monitor group status (STATUS)

The group is automatically turned off when OVC (threshold: 10 mA) occurs (PDwn)

4.1.4 SY 1527 messages

The following messages may be returned by the SY 1527 when monitoring the group STATUS:

- OFF (channels turned OFF)
- RUP (channels ramping up)
- RDWN (channels ramping down)
- OVC (channels in OVERCURRENT condition)
- OVV (channels in OVERVOLTAGE condition)
- UNV (channels in UNDERVOLTAGE condition)
- EXTTRIP (channels OFF due to external TRIP line signal)
- INTTRIP (channels OFF due to internal OVERCURRENT condition)
- EXT_DIS (channels disabled by board INTERLOCK protection)

Moreover it is possible to monitor board temperature and to check board status; the following messages may be returned by the SY 1527 when monitoring the board status:

- UNDER_TEMP (board temperature < 5°C)
- OVER_TEMP (board temperature > 65°C)

4.2 HV channels INTERLOCK[6]

The following procedures must be performed in order to enable the channels switch on:

- Providing either the PASSIVE INTERLOCK connector with a 50 Ohm termination or supplying the SIGNAL INTERLOCK connector with a +5 V (3~4 mA) differential signal (see §2.4.2). These operations are not necessary if the Jp2 jumper (see § 2.4.4) is connected.

[6] Please refer to § 2.4.3 for the INTERLOCK LED operation

- Connector INTERLOCK: Pin 51 and Pin 52 (IINT and IEXT) of the HV Multipin Connector have to be short circuited in order to allow the channels turning on; this is a safety feature (see § 2.4.2).

4.3 Grounding specifications

The Mod. A1932A channels share a common floating ground (FAGND, see § 2.4.2), available on the front panel both on the multipin connector and on a LEMO connector, which does not coincide with the crate ground (AGND, see § 2.4.2), which is available as front panel LEMO connector. This feature allows on-detector grounding, thus avoiding loops which may increase noise level. FAGND and AGND may be coupled in several ways, according to the environment requirements.